

Ozone Health Effects: Findings of the First Draft Staff Paper

Susan Lyon Stone

2006 National Air Quality Conference

February 6, 2006

stone.susan@epa.gov



Purpose of this First Draft Staff Paper

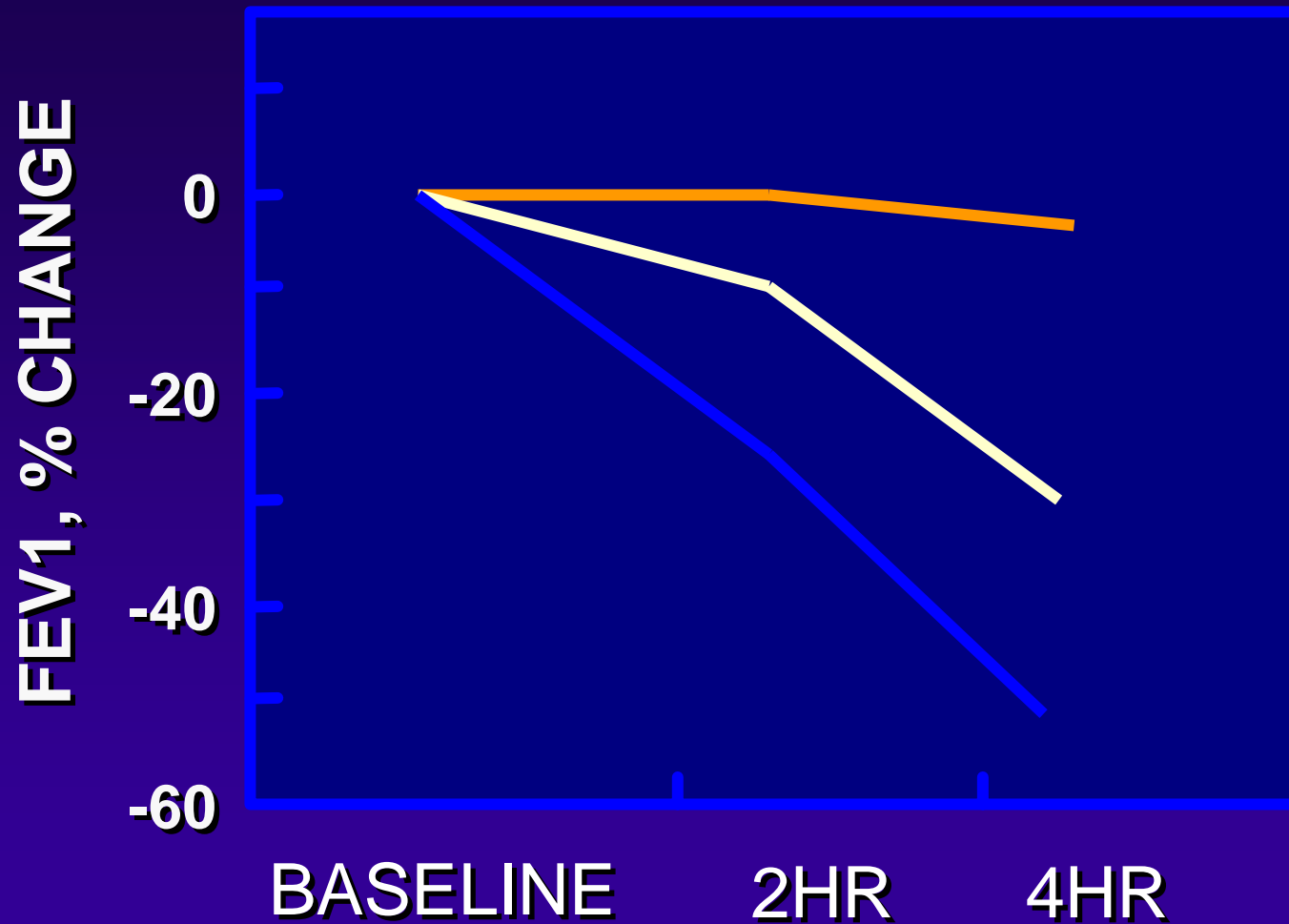
- To conclude whether consideration should be given to revising existing primary O₃ NAAQS
- If so, what alternative standards should be considered for additional exposure and risk assessments
- The results of those assessments will inform staff recommendations on primary O₃ NAAQS in next draft Staff Paper

Ozone Irritates Airways

- Symptoms
 - Cough
 - Sore or scratchy throat
 - Pain with deep breath
 - Fatigue
- Rapid onset
- Similar symptoms - people with and without asthma



Ozone Reduces Lung Function



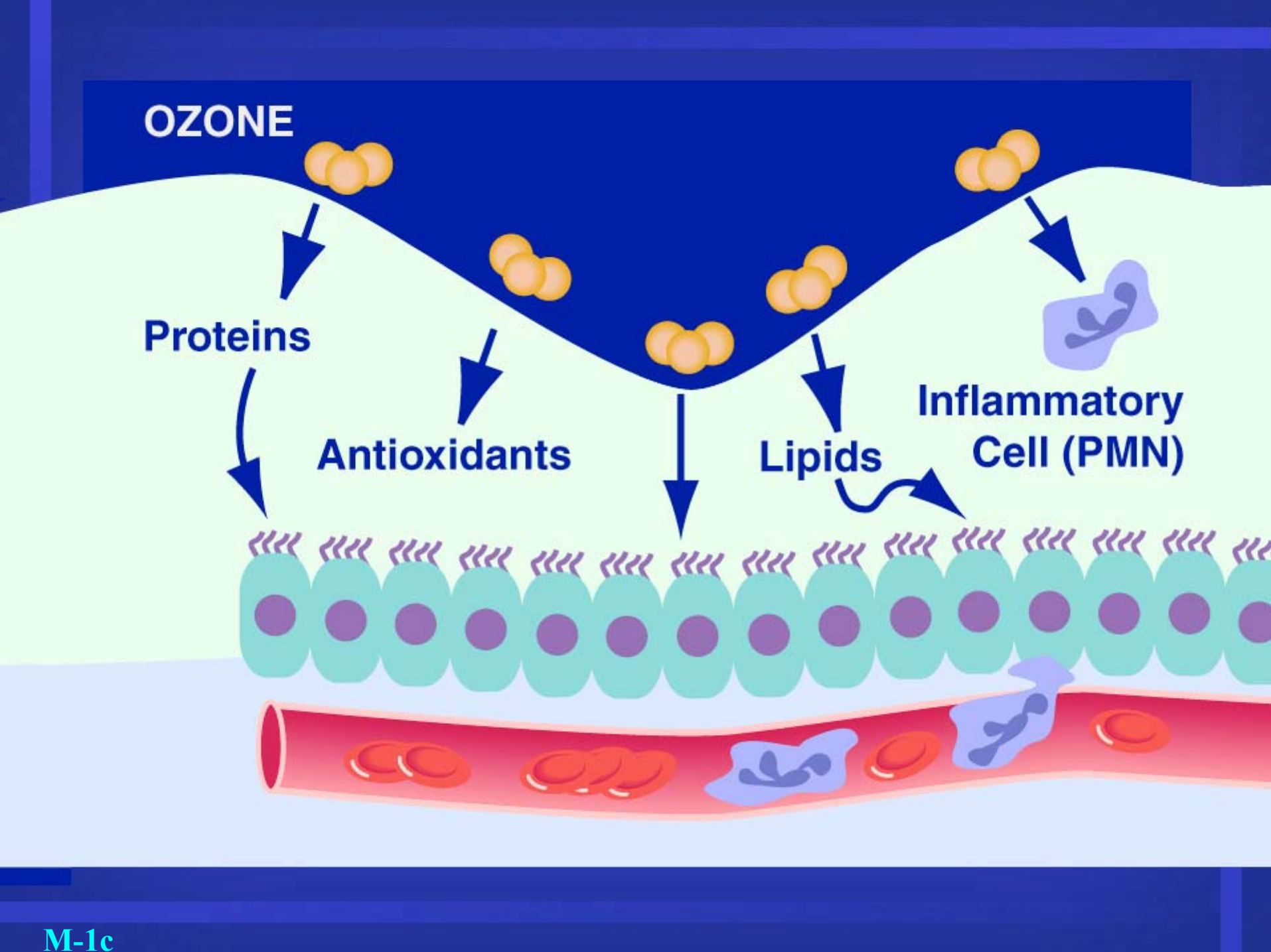
OZONE

Proteins

Antioxidants

Lipids

**Inflammatory
Cell (PMN)**



Respiratory Morbidity

- Physiological bases of increased sensitivity of people with asthma
 - Larger decreases lung function
 - Increased occurrence and duration nonspecific airway responsiveness
 - Increased airway responsiveness to allergens
 - Increased inflammatory responses

Respiratory Morbidity (cont.)

- Hospital admissions
- Emergency room visits
- School absences
- Increased symptoms and medication use in children

Cardiovascular Morbidity - Very Limited Evidence

- Animal toxicology – hematological and thermoregulatory alterations
- Human exposure - impairment alveolar-oxygen transfer and ventilation-perfusion mismatch
- Epidemiology – myocardial infarction, changes in heart rate variability and arrhythmias

Mortality

- Single city studies with statistically significant results have 98 and 99 percentile values below O₃ NAAQS
- US multi-city time-series studies provide strong evidence of association between short-term O₃ exposure and mortality
- Effects robust to confounding by copollutants

Exposure Assessments

- Exposures of concern – 8-hour average exposures above 0.08 ppm
- Twelve urban areas across the US
- Two air quality scenarios – recent year (2004) and just meets 8-hour O₃ NAAQS
- Active people, all children, active children

Exposure Estimates

Exposures of Concern (above 0.08 ppm, in thousands)			
	Active People	All Children	Active Children
Recent Year - 2004	1,598	618	376
Just Meets Standard	50	17	11

Risk Assessments – Lung Function

- All exposures above background that resulted in:
 - Moderate decrements or $\geq 15\%$ reduction FEV_1
 - Large decrements or $\geq 20\%$ reduction FEV_1
- Same 12 urban areas and 2 air quality scenarios - recent air quality (2004) and just meets 8-hour O_3 NAAQS
- All children and active children

Risk Estimates – Lung Function

Air Quality Scenario	Level of Lung Function Decrement	All Children - Ages 5-18 (18.1 million total)	
		Persons (thousands and % of population in parentheses)	Person Days (thousands)
2004	$\geq 15\%$	1,728 (10%)	15,410
Just Meets	$\geq 15\%$	1,156 (6%)	7,640
2004	$\geq 20\%$	433 (2%)	1,208
Just Meets	$\geq 20\%$	134 (1%)	211

Risk Assessment – Unscheduled Hospital Admissions

- New York City for recent year (2004) and just meets 8-hour O₃ NAAQS
- Total respiratory illness – recent year
 - 450 cases or 5.6 per 100,000 relevant population
- Asthma (subset of total) – recent year
 - 380 cases, 4.8 per 100,000 relevant population
- Reduction in incidence for both total respiratory and asthma-related admissions about 19% from just meeting O₃ NAAQS

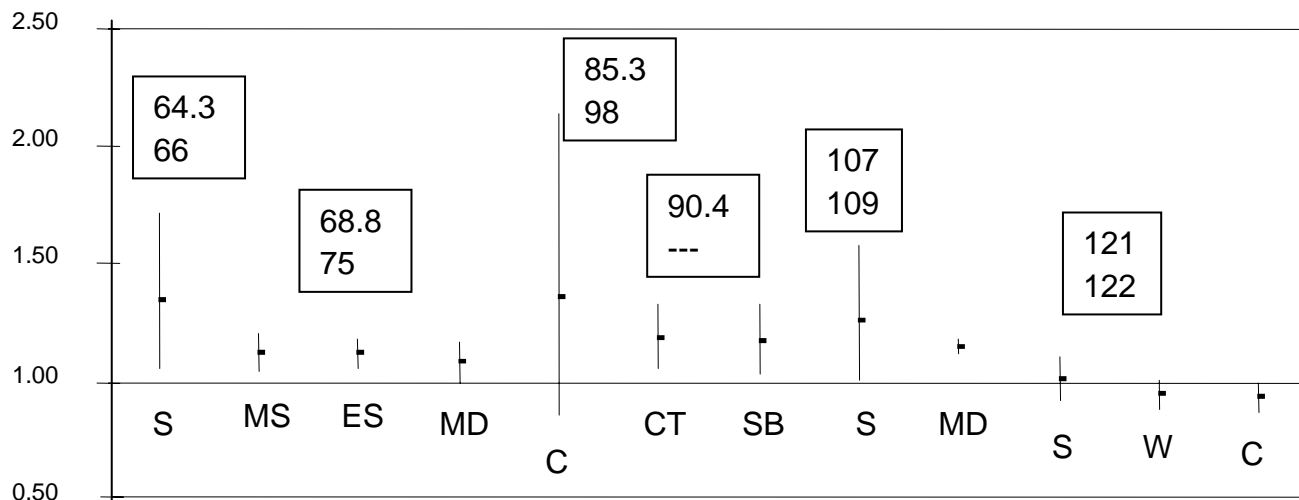
Risk Assessments - Mortality

- Estimated non-accidental and cardiorespiratory mortality
 - Recent year (2004) and just meets 8-hour O₃ NAAQS
 - Single city and multi-city models
- Nonaccidental mortality
 - Recent year – 0.4 to 7.3 per 100,000
 - Just meets – 0.3 to 5.7 per 100,000
- Cardiorespiratory mortality
 - Recent year – 0.4 to 1.3 per 100,000
 - Just meets – 0.2 to 0.9 per 100,000

Conclusions

- Averaging time
 - 8-hour average protects against short-term and prolonged exposures
 - Not appropriate at this time to conduct analyses of long-term exposures
- Form – nth-highest concentration
- Level
 - Better understanding of physiological mechanisms of effects
 - No apparent threshold for health effects
 - Sufficient risks of various health endpoints remain after meeting current standard that additional analyses of alternative standards appropriate

Odds Ratios (with 95% confidence intervals) for associations between O₃ and respiratory symptoms, from warm season analyses, in order of increasing 98th and 99th percentile 8-hr O₃ concentrations (in boxes)



LEGEND:

S = asthma symptoms
 MS = morning symptoms
 ES = evening symptoms
 MD = med use
 CT = chest tightness
 SB = shortness of breath
 C = cough
 W = wheeze

Mortimer et al., 2002, 8 US cities

Ross et al., 2002, East Moline IL

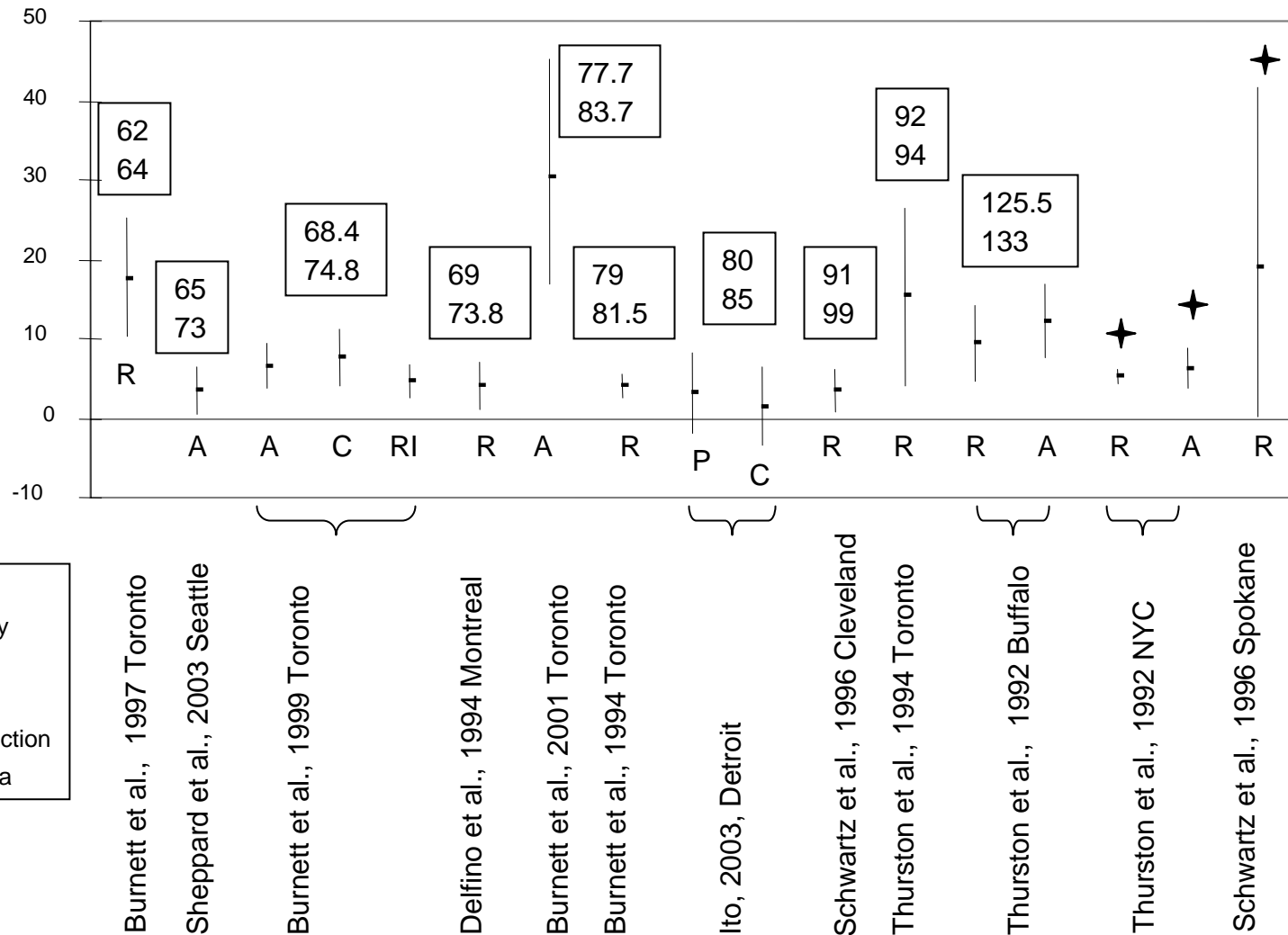
Neas et al., 1995, Uniontown PA

Gent et al., 2003, New England cities

Delfino et al., 2003, San Diego CA

Ostro et al., 2001, Los Angeles CA

Effect estimates (with 95% confidence intervals) for associations between O₃ and hospitalization for respiratory diseases, in warm season analyses, in order of increasing 98th and 99th percentile 8-hr O₃ concentrations (in boxes)



★ 98th percentile values not available; are likely high-end concentrations based on data provided in study

Additional Exposure and Risk Assessments

- Level of 0.06 ppm lowest air quality statistic credibly and significantly associated with increased respiratory morbidity effects such as symptoms and hospital admissions, and also daily mortality
- Additional assessments of alternative 8-hour average standards:
 - 0.08 ppm, third-highest concentration
 - 0.07 ppm, third- through fifth-highest concentrations
 - 0.06 ppm, third- through fifth-highest concentrations

Sensitive Groups

- Active people
- People with lung disease
- Children
- Older adults
- DOES NOT INCLUDE PEOPLE WITH HEART DISEASE